



Exploration of seaweed consumption in Norway using the norm activation model: The moderator role of food innovativeness

Florent Govaerts^{a,b,*}, Svein Ottar Olsen^b

^a Nofima, Norwegian Institute of Food, Fisheries and Aquaculture Research, 9-13 Breivika, PO Box 6122, NO-9291 Tromsø, Norway

^b School of Business and Economics, UiT The Arctic University of Norway, PO Box 6050 Langnes, N-9037 Tromsø, Norway

ARTICLE INFO

Keywords:

Norm activation model
Seaweed food consumption
Consumer food innovativeness
Prospective design
Pro-environmental behaviour

ABSTRACT

Seaweed is considered to be a sustainable and healthy food source. However, for western consumers, it remains an unfamiliar source of food. Using a sample of 426 Norwegian consumers, this study aimed to explain and predict seaweed consumption using an extended version of the norm activation framework with a prospective design, including behaviour and consumer food innovativeness. Confirmatory factor analysis was conducted to validate the reliability of the measurements, while structural equation modelling was applied to test the hypothesised relationships. The findings support the ability of the norm activation framework to explain the intention of consuming seaweed. Moreover, this study determined a positive relationship between awareness of health consequences and intention, as well as ascription of responsibility and intention. Intention and food innovativeness are both predictors of seaweed consumption. Consumer food innovativeness positively moderates the relationship between intention and seaweed consumption.

1. Introduction

Our food system is confronted with important challenges. Globally, a range of issues including climate change, population growth, over-exploitation of land resources, malnutrition, and poor nutrition are pressing societies to find and promote new sustainable food sources. Additionally, in the western countries, consumers are becoming increasingly aware of the environmental and health issues caused by food consumption. Consequently, food trends pertaining to natural, local, organic, traceable, and functional foods are becoming increasingly popular among consumers (Aertsens et al., 2009; Feldmann & Hamm, 2015; Perera et al., 2018).

In the context of this global trend towards a more sustainable and healthy food production and consumption, seaweed is considered to be a promising new food source in the western markets. First, seaweed is considered a sustainable food source (Kim et al., 2017; Lenstra, et al., 2011), whose production does not require soil, fresh water, or fertiliser (Buschmann et al., 2017), and which removes and stores carbon dioxide from the atmosphere (Duarte et al., 2017). Second, seaweed is a healthy low calorie and highly nutritional food source. It is especially known for its high content of iodine, vitamins, and fibre (Mabeau & Fleurence, 1993). Some seaweeds are rich in proteins, such as the 'Nori' green

seaweed which contains up to 47% proteins (Prager, 2016). Finally, seaweed is tasteful (Wendin & Undeland, 2020) but remains unfamiliar to western consumers (Birch et al., 2019). Hence, new seaweed products can provide to western consumers new taste experiences.

In the literature, only few studies have focused on seaweed from the perspective of consumer behaviour (Birch et al., 2019; De Boer et al., 2013; Palmieri & Forleo, 2020, 2021; Wendin & Undeland, 2020). Understanding how and why consumers adapt and use new food products and services is important since there is a need for consumer insight which would help the seaweed industry to develop a new and sustainable food product (Stévant et al., 2017). Therefore, the main objective of this study is to understand consumers' motivation for consuming seaweed food products from a sustainable and environmental behavioural perspective.

Several studies focus on consumer behaviour towards sustainable products and services (Trudel, 2018; White et al., 2019) using theories and models such as the theory of planned behaviour (TPB) (Ajzen, 1991), habit theory (Verplanken & Aarts, 1999), alphabet theory (Zepeda & Deal, 2009), the norm activation model (NAM) (Schwartz, 1977), value-belief-norm model (Stern, 2000), and combinations and extensions of these models (Kim & Hwang, 2020; Klöckner, 2013; Nordlund et al., 2018).

* Corresponding author.

E-mail addresses: florent.govaerts@nofima.no (F. Govaerts), svein.o.olsen@uit.no (S.O. Olsen).

<https://doi.org/10.1016/j.foodqual.2021.104511>

Received 24 August 2021; Received in revised form 20 December 2021; Accepted 22 December 2021

Available online 8 February 2022

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Seaweed is a new food source for most western consumers. Thus, a lack of knowledge and awareness of this source of protein and its benefits to the environment and health may be a consumption barrier. Several environmental consumption theories suggest that belief, knowledge, and awareness activate personal norm (Schwartz, 1977; Steg & Groot, 2010; Ünal et al., 2018). Therefore, this study contributes to the existing food consumption literature, using the NAM (Schwartz, 1977) to explore seaweed consumption. The NAM model assumes that behaviour results from the activation of personal norm by ascription of responsibility and awareness of consequences. The structural relationship between the constructs in the NAM varies across products and contexts (De Groot & Steg, 2009; Han et al., 2015; Kim & Hwang, 2020; Onwezen et al., 2013) due to which an alternative model structure is often considered (Onwezen et al., 2013; Zhang et al., 2018).

Moreover, most studies on pro-environmental behaviour using the NAM do not examine the relationship between intention and behaviour. Solely using intentional behaviour to explain consumer behaviour is problematic as there tends to be an important gap between consumer's intentions and behaviour (Armitage & Conner, 2001; Rhodes & de Bruijn, 2013; Sheeran, 2002), especially in the area of sustainable, ethical, and pro-environmental consumption (Carrington et al., 2014; Hassan et al., 2016; Vermeir & Verbeke, 2006). However, some studies that use the NAM by including behaviour, apply a cross sectional survey and measure past behaviour and intention simultaneously (e.g., Han, 2014). Hence, to solve this problem, this study extends previous studies using the NAM to explore intention-behaviour relationship using a prospective research design (Fishbein & Ajzen, 2010). The practice of predicting and measuring behaviour one month after measuring intention is frequently used in the original TPB (Carfora et al., 2019) and exhibits a theoretical advantage concerning causality (Aguilar-Luzón et al., 2012; Ajzen, 1985; Ajzen et al., 2004) as well as a methodological advantage in forming and reducing common method bias or carryover effects (Podsakoff et al., 2003; Tourangeau et al., 1989). This study addresses these theoretical and methodological shortcomings of previous studies using the NAM.

In the context of novel or unfamiliar foods such as insects (Mancini et al., 2019; Onwezen et al., 2019), only a small fraction of adventurous food innovators would eat seaweed, while the majority would avoid it for the fear of the unknown. Knowing that innovative food consumers are more adept at adopting new foods, this study extends the established literature (e.g., Mancini et al., 2019; Onwezen et al., 2019) by testing the role of consumer food innovativeness in the prediction of consumption behaviour and as a moderator between intention and behaviour in a prospective design. To the best of our knowledge, this is the first study that tests the relationship between consumer food innovativeness and behaviour with a prospective design.

2. Theoretical framework

The TPB (Ajzen, 1991) is probably the most frequently used theory to explain and predict sustainable food products, such as ethical foods (O'Connor et al., 2017), organic and green foods (Carfora et al., 2019), and new sustainable food products (Mancini et al., 2019; Onwezen et al., 2019). In the area of sustainable and environmental theories, the value-attitude-behavioural framework is frequently used to explain a multitude of pro-environmental attitudes and behaviours regarding recycling (Gkargkavouzi et al., 2019), energy conservation (Abrahamse & Steg, 2011), transportation (Jakovcovic & Steg, 2013), green hotel setting (Choi et al., 2015), and environmentally friendly eating (Kim et al., 2020). When the NAM is used in food behaviour, it is also integrated with either the TPB or the value-attitude-behavioural framework (Kim & Hwang, 2020; Shin et al., 2018). This study applies the basic and linear NAM with alternative model structures, extends the linear model with prospective design, and measures the influence of consumer food innovativeness on consumption in the context of novel/unfamiliar sustainable food.

2.1. Norm activation model

The NAM developed by Schwartz (1977), to explore altruistic behaviour, is widely used today to study sustainable attitudes and intention (Joanes, 2019; Kiatkawsin et al., 2020; Onwezen et al., 2013). NAM is a sequential linear model that argues that intention or behaviour is the result of the activation of personal norm. The core construct of the model personal norm is defined by Schwartz (1977, p. 227) as 'the self-expectations for specific action in particular situations that are constructed by the individual'. Personal norm is also defined as the 'feeling or responsibility for the negative consequences of not acting pro-socially' (De Groot & Steg, 2009, p. 426). In this study, personal norm is defined as the feeling of moral and environmental obligation to buy and eat seaweed.

Two factors activate the personal norm in the model: awareness of consequences and ascription of responsibility. Awareness of consequences is defined as the level of consciousness of the potential repercussion of a performed action (Schwartz, 1977). Recent studies refer to awareness of consequences as the degree to which a person is mindful of the adverse consequences for others or for things one values, when not acting pro-socially (De Groot & Steg, 2009; Hansla et al., 2008). Consumers are willing to consume environmentally friendly foods, like organic foods, not just for environmental and social consequences, but for better quality, health, and other more 'egoistic' benefits (Kushwah et al., 2019). Thus, this study refers to awareness of consequences of health consequence, as seaweed is considered to have positive health consequence (O'Connor, 2017; Pereira, 2016). The other main factor, ascription of responsibility, indicates a person's feelings of responsibility for consequences of a behaviour (Schwartz, 1977). In this study's context, we refer to ascription of responsibility as the feeling of responsibility to reduce environmental problems (e.g., climate change and pressure on land resources) by consuming seaweed.

This study defines intention as an indication of how hard people are willing to try, and how much effort they are planning to exert, to eat seaweed in the future (Ajzen, 1991). This study defines behaviour as a person's self-reported consumption of seaweed. It is measured one month after the assessment of intention (prospective design; Future consumption). A visual presentation of our conceptual model with hypotheses is presented in Fig. 1.

2.2. Relationships between ascription of responsibility, personal norm, and intention

According to De Groot & Steg (2009), a person must first be aware of the consequences of a behaviour before feeling responsible for it. Thus, the model assumes that feelings of responsibility would activate personal norm. When personal norm is activated, it influences individual intention directly and behaviour indirectly (see Fig. 1: in blue the original NAM) (Harland et al., 2007). For example, regarding pro-environmental intention and behaviour, personal norm is stronger when people are aware of the environmental problems caused by their behaviour, and when they feel personally responsible for these problems and do not blame these problems on the actions of others (Schwartz, 1977; Van Liere & Dunlap, 1978). Moreover, personal norm is stronger when people feel that they can contribute to solving or reducing the problem (Bamberg et al., 2007; Schwartz, 1977; Stern, 2000).

Many studies have supported the NAM linear direct relationships (ascription of responsibility → personal norm → intention) in diverse environmentally friendly behaviour, such as energy-saving (Song et al., 2019; van der Werff & Steg, 2015), eco-friendly tourism behaviour (Han et al., 2015; Han et al., 2019; Kiatkawsin & Han, 2017) and transport behaviour (De Groot & Steg, 2008; He & Zhan, 2018; Nordlund et al., 2018). For example, Shin et al. (2018) included the TPB and the NAM to study consumer behaviour toward organic menus and found a high relationship between ascription of responsibility and personal norm ($\beta = 0.50$), and between personal norm and intention ($\beta = 0.26$). However,

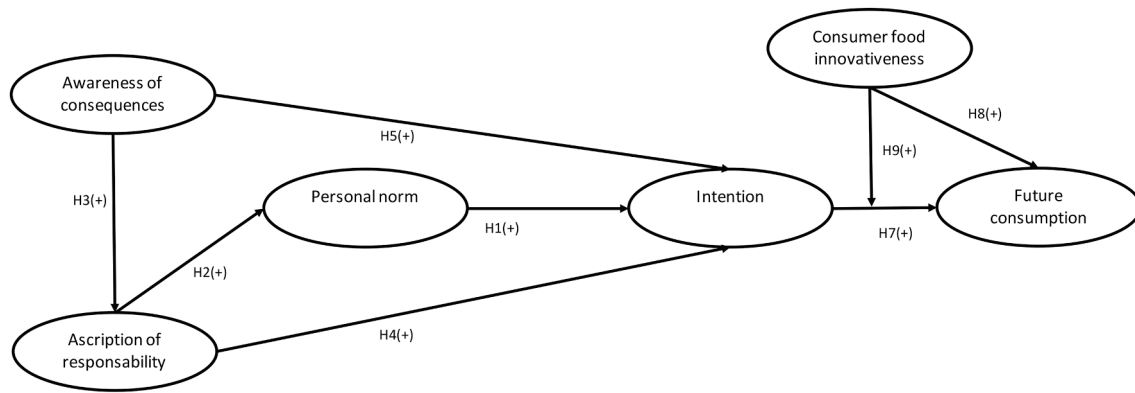


Fig. 1. Proposed conceptual model with hypotheses.

to the best of our knowledge, this is the first study that uses the NAM framework to study novel/unfamiliar sustainable food consumption, but there is reason to believe that because seaweed has pro-environmental advantages (see our introduction), a positive relationship exists between ascription of responsibility and personal norm, and personal norm and intention in our context. Integrating the theoretical and empirical backgrounds, the following hypotheses are proposed:

H1: Increasing personal norm leads to higher intention to eat seaweed.

H2: Increasing ascription of responsibility leads to higher personal norm.

2.3. Awareness of (health) consequences

Seaweed is considered to have pro-environmental consequences and health benefits for consumers (Pereira, 2016). Health benefits are important for consumers' food choice (Hughner et al., 2007; Rana & Paul, 2017), especially for foods like seaweed, vegetables, and organic food (e.g., Birch et al., 2019; Kushwah et al., 2019). In addition, recent literature has underlined a relationship between consumer health awareness and sustainable food consumption (Kriwy & Mecking, 2012; Tarkiainen & Sundqvist, 2009). In practice, consumers are more likely to eat sustainable foods as they are considered healthier than traditional foods. Hansen et al. (2018) showed that health consciousness is positively related to personal identification as an organic food consumer. Magnusson et al. (2003) demonstrated that perceived health benefits are stronger indicators of pro-environmental food behaviour than perceived environmental benefits. Thus, this study contributes to the existing NAM literature by exploring the possible positive relation between awareness of health consequences and ascription of responsibility.

Accordingly, the following hypothesis was formulated:

H3: Increasing awareness of health consequences leads to higher ascription of responsibility.

2.4. Alternative routes to pro-environmental food behavioural intentions

Alternative model structures to the NAM are often considered (Onwezen et al., 2013; Rosenthal et al., 2020; Steg & Groot, 2010; Zhang et al., 2018). For instance, Zhang et al. (2018) tested the moderating effect of awareness of consequences and ascription of responsibility on the relationship between personal norm and behaviour, while Kim et al. (2018) explored the mediating effect of ascription of responsibility on the relationship between awareness of consequences and personal norm. Similar to the previous studies cited, this study applies an alternative model structure to the original linear structure of the NAM proposed by Schwartz (1977).

Generally, studies have considered personal norm towards pro-environmental action as a mediator between ascription of responsibility and intention (e.g., Choi et al., 2015; De Groot & Steg, 2008;

Gkargkavouzi et al., 2019; Jakovcevic & Steg, 2013). Few studies have considered the association between ascription of responsibility and pro-environmental behavioural intention. To the best of our knowledge, three studies have indicated a positive effect of ascription of responsibility on eco-friendly behaviours (Vaske et al., 2015; Verma et al., 2019) and on the pro-environmental behaviours of public servants (Fang et al., 2019). Based on the above observations, in the context of novel foods, it is reasonable to assume that consumers who feel responsible for the environment are more likely to intend to eat seaweed. Moreover, in some circumstances, ascription of responsibility does not activate moral norms, but rather triggers intention to consume seaweed directly or indirectly through other mediators (e.g. Onwezen et al., 2013; Vaske et al., 2015). For example, Kiatkawsin and Han (2017) indicated that ascription of responsibility influenced intention through individual's expectancy that environmental action will lead to an outcome, in addition to pro-environmental personal norm.

Hence, the following hypothesis is proposed:

H4: Increasing ascription of responsibility leads to higher intention to eat seaweed.

An alternative NAM model showed a strong relationship between awareness of consequences and consumer pro-environmental intention in the context of tourism (Vaske et al., 2015), energy (van der Werff & Steg, 2015), and cosmetics (Munerah, Koay, & Thambiah, 2021). Several studies integrating the NAM with other theories confirm that awareness of consequences directly and indirectly influences intention through other mediators besides personal norm, such as attitudes (Kim & Hwang, 2020), subjective norms, and perceived behavioural control (Zhang et al., 2017). In the context of food consumption, health is a significant factor for consumers when purchasing food (Rana & Paul, 2017; Wandel & Bugge, 1997). Hence, consumers with higher health knowledge are more likely to have positive attitudes towards healthy foods and organic foods (Rana & Paul, 2017). Lee et al. (2013) showed that health concerns and health knowledge significantly affect intention to eat healthy foods. At the same time, other studies indicate a strong association between sustainable foods and health benefits (Bryła, 2016; Lea & Worsley, 2005). Loebnitz & Grunert (2018) have also indicated that health-conscious consumers show higher intention to buy sustainable foods. Thus, in line with previous findings, there is reason to believe that consumers with higher awareness of health consequences will have higher intention to eat seaweed than consumers with lower awareness. Thus, the following hypothesis is proposed,

H5: Increasing awareness of health consequences leads to higher intention to eat seaweed.

Finally, previous studies emphasised the mediating role of responsibility as individuals must be aware of the consequence of behaviour to feel responsible for it (De Groot & Steg, 2009; Onwezen et al., 2013). However, most of the studies measured the direct effect of ascription of responsibility while just a few considered ascription of responsibility as a mediator between awareness of consequences and

intentions (Fang et al., 2019; Vaske et al., 2015). Furthermore, it is known that a relationship exists between health awareness and pro-environmental concern (Rana & Paul, 2017; Wandel & Bugge, 1997), but there are no extant studies considering the mediating effect of pro-environmental feeling of responsibility on the relationship between the awareness of health consequences, and intention to eat pro-environmental foods. Therefore, we assume that aware consumers feel a greater sense of responsibility to eat seaweed and that ascription of responsibility is positively related to intention to eat seaweed and serves as a mediator between awareness of health consequences and intention to eat seaweed. Accordingly, the following hypothesis was formulated:

H6: The relationship between awareness of health consequences and intention to eat seaweed is mediated by ascription of responsibility.

2.5. Intention-behaviour gap under prospective design

Intention is suggested to be the most important predictor of an individual's behaviour within attitude-behavioural theories like the TPB (Fishbein & Ajzen, 2010; Sheeran, 2002). Thus, most studies that use the NAM (e.g., He & Zhan, 2018; Kim & Hwang, 2020; Zang et al., 2017; 2018) or include the NAM in other theories (e.g., the TPB) (e.g., Zhang et al., 2020; Kiatkawsin & Han, 2017; Rezaei et al., 2019) to define intention as the ultimate dependent variable. Few studies use past behaviour or a combination of intention and past behaviour (e.g., Lopes et al., 2019; Onwezen et al., 2013; Udo et al., 2016). However, intention and behaviour are separate concepts, and the relationship between them is controversial (Armitage & Conner, 2001; Rhodes & de Bruijn, 2013; Sheeran & Webb, 2016), especially regarding pro-environmental behaviour (Glimmer & Miles, 2017) and ethical consumption (Carrington et al., 2010; Hassan et al., 2016). The gap between intention and consumption in the area of sustainable foods (Vermeir & Verbeke, 2006) and healthy foods (Conner et al., 2002) is well documented in the existing literature.

All NAM studies we know, including the intention-behaviour relationship in the NAM sequential and linear structure, use 'past behaviour' as an outcome of intention to behave. This study follows the reason action approach of the TPB and uses a prospective design (Fishbein & Ajzen, 2010) assessing self-reported behaviour, one month after assessing intention. Thus, this study explains variations in intention and explores if and how intention predicts future behaviour as suggested by original versions of the TPB. This not only strengthens the theoretical causal relationship between constructs in the theoretical model (Fig. 1), but temporal separation reduces the possibility for common method bias and carryover effects (Podsakoff et al., 2003; Podsakoff et al., 2012; Tourangeau et al., 1989). To better understand the relationship between intention and behaviour, this study extended the NAM by integrating behaviour into the linear structure and assessing seaweed consumption one month after measuring intention to consume seaweed within the coming month (prospective design). Based on this discussion the following hypothesis is proposed.

H7: Consumer's intention to consume seaweed predict future consumption of seaweed.

2.6. The role of consumer food innovativeness

Seaweed is traditionally eaten in Asia (for example, in China, Japan, Korea, and Thailand), where its nutritional properties and flavours are prized (Chapman et al., 2015; Stévant et al., 2017). However, it is still unfamiliar and largely unknown to consumers. In Norway, historical records reveal the use of seaweed in the diet during the Viking age, over 1000 years ago; however, its use has almost disappeared from the traditional Norwegian diet. Nowadays, seaweed food products remain new to Norwegian consumers.

In this context, the effect of consumer food innovativeness on seaweed food consumption is relevant as previous studies have shown that it plays an important role in the willingness to buy and consume and

pay for new food products (Bartels & Reinders, 2010; Persaud & Schillo, 2017). Thus, this study includes consumer food innovativeness (Fu & Elliott, 2013; Goldsmith & Hofacker, 1991) in our conceptual framework (see Fig. 1) to extend our understanding of consumers' motivation to consume novel food, such as seaweed.

Consumer innovativeness is a frequently used term in consumer behaviour studies for all types of goods and services and defines innovativeness as a general theoretical construct across academic disciplines. Literature defines consumer innovativeness as the tendency to purchase new products, services, or ideas earlier than the majority of consumers or as the tendency to be attracted to new products after their apparition in the market (Foxall et al., 1998). Traditionally, innovativeness is viewed as depending on personality as some customers have an innate predisposition to adopt new products, services, or brands before others (Hoffmann & Soye, 2010; Hurt et al., 1977; Midgley & Dowling, 1978). In contrast, the concept of domain specific innovativeness, introduced by Goldsmith & Hofacker (1991), focuses on consumer innovativeness for a specific product category. It proposes that consumers' adoption of innovation in a specific domain does not guarantee their adoption of innovation in another domain. In other words, a consumer can be innovative with some specific products or services such as food, but not with others such as clothes or wine. Thus, consumers food innovativeness refers to consumers tendency to purchase new food products

Consumer innovativeness is related to individual differences in personality, values, attitudes, intentions, and behavioural variables (Bartels & Reinders, 2010). It is suggested that consumer innovativeness influences intention to buy, use, or pay for new products (Flynn & Goldsmith, 1993; Fu & Elliott, 2013) or services (Liu, 2013). In general, the relationship between innovativeness and buying behaviour of new products is positive across products and services (Bartels & Reinders, 2010). Regarding novel foods, previous studies have shown that highly innovative food consumers are more willing to buy organic foods (Bartels & Reinders, 2010), but this can differ between cultures (Altintzoglou et al., 2016).

This study seeks to test whether and how consumer food innovativeness is associated with consumption of novel food (seaweed). Thus, the following hypothesis is proposed,

H8: Increasing consumer food innovativeness leads to higher future consumption of seaweed.

In the literature, personal innovativeness has been used as a moderator between various variables in various contexts (Fang et al., 2009; Fu & Elliott, 2013; Herrero Crespo & Rodríguez del Bosque, 2008). For example, Fang et al. (2009) studied the moderating effect of innovativeness on attitude and intention to participate in an online survey. Persaud and Schillo (2016) investigated the moderation role of innovativeness on the relationship between identity and intention to purchase organic food. However, to the best of our knowledge, no studies are investigating the moderating effect of innovativeness on the intention-behaviour relationship with a prospective design (future consumption).

Furthermore, as seaweed is not a part of the Norwegian food culture, it is expected that only a minority of the sample will consume seaweed between the first and the second survey, thereby generating a large gap between intention and future behaviour. Food innovative consumers are believed to be more likely to take the last step between intending to consume seaweed and consuming seaweed; it is expected that the gap between intention and behaviour will be lower as the consumer is food innovative. Thus, the following hypothesis is proposed,

H9: Consumer food innovativeness has a positive moderating effect on the intention- future consumption of seaweed relationship.

3. Methodology

3.1. Data collection

Data for this study were collected via a questionnaire survey carried

out through the intermediary of an online international survey research firm (Yougov) in June 2020. The sample was representative of gender, age, and region of Norwegian consumers. The sample consisted of 426 adult participants aged 18 years old and above, of whom 51% were male. The majority of respondents were well-educated (university or university college) (59%), and most lived in households without children (72.7%). Table 1 summarises the socio-demographic characteristics of the sample.

The survey consisted of two questionnaires which were administered at two different times (t1 and t2). The first questionnaire, which required approximately 8–11 min to complete, consisted of four components of NAM (awareness of health consequences, ascription of responsibility, personal norm, and intention), and consumer food innovativeness, together with some other constructs not reported in this study.

The second questionnaire was administered about one month after. This questionnaire was shorter as it contained a single item measuring seaweed consumption behaviour. The same participants participated in the second questionnaire. However, to avoid the data being influenced, at the first questionnaire round, participants were not informed of our intention to conduct another round a month later. The study only includes data from participants who filled out both questionnaires (t1 and t2).

As seaweed food products are relatively unknown in the Norwegian food culture, a series of pictures of seaweed food products were presented to the participants. The food products presented in the survey are all available on the Norwegian market. Some of these are popular in Asian countries and have been imported to Norway. For instance, the respondents were presented with pictures of sea grapes (also called green caviar: used as a side dish in Asia), sushi (in sushi, the Nori seaweed is used to wrap the roll) and wakame (often used as a side dish in Japanese restaurant) (Fig. 2).

Pictures of Norwegian produced seaweed were also presented in the survey, such as pictures of snacks (chocolate and chips), cheese, and drinks containing local seaweed, along with a short descriptive text for each picture.

3.2. Measurement instruments

The measurement instruments used were adopted from prior studies and amended to suit the present study setting. The questionnaire was presented in Norwegian, and the items were placed in a randomised order.

Participants' awareness of health consequences was measured using three items adapted from De Groot and Steg (2009) to reflect consciousness of the health benefit of seaweed: 'Seaweed products can be

Table 1
Socio-demographic characteristics (N = 426).

Variables	Percentage
Gender	
Female	51.64
Male	48.36
Age	
18–29 y/o	16.43
30–39 y/o	17.14
40–49 y/o	15.96
50–59 y/o	18.31
≥60 y/o	32.16
Children living at home	
Yes	27.23
No	72.77
Level of education	
Primary and lower secondary school	7.04
Upper secondary school	33.16
University or university college (1–3 years)	31.69
University or university college (4 years or more)	27.80

considered as superfood', 'Seaweed products are good for your health', and 'Seaweed can be considered as the vegetable of the sea'. The ascription of responsibility was measured using three items adapted from De Groot and Steg (2009): 'Eating seaweed can contribute to the fight against climate change', 'I feel that people should eat (more) seaweed to reduce the impact of food on the climate' and 'Every person should eat seaweed to reduce the pressure on land resources'. Personal norm was assessed using three items adopted from Jakovcivic and Steg (2013). The measurement items for these three constructs were adapted to fit the context of seaweed food consumption. To measure awareness of health consequences, ascription of responsibility, and personal norm, respondents were asked for each item to indicate to what extent they disagreed or agreed with the statement on a scale, ranging from 1 = 'strongly disagree' to 7 = 'strongly agree'. Table 2 shows the measurement items used to measure awareness of health consequences, ascription of responsibility, and personal norm.

Intention to eat seaweed was measured by rating three items on a scale from 1 to 7 (extremely unlikely/extremely likely). The items were adapted from Menozzi et al. (2017). As it is not common to find seaweed food products in Norwegian stores, a short introduction preceded the three items: 'If seaweed products are readily available in the stores you usually shop in, how likely is it that you will eat them in the time to come'. The three items used to assess behavioural intention were: 'I intend to eat products containing seaweed in the future', 'I expect to eat products containing seaweed in the future', and 'I will try to eat products containing seaweed in the future'.

Three items borrowed from Goldsmith & Hofacker (1991) were used to measure the latent variable consumer food innovativeness. A 7-point bipolar rating scale from 1 = 'strongly disagree' to 7 = 'strongly agree' was used. The items consisted in 'I am constantly sampling new and different foods', 'I try new foods before other people do' and 'Compared to my friends, I try more new foods'.

Future consumption of seaweed consisted of asking the frequencies with which respondents bought seaweed food products during the last month. Prospective seaweed consumption was assessed on a scale from 0 (none) to 10 (10 times), following the question 'How many times in the last month have you eaten a product that contained seaweed?'. However, as the data was not normally distributed, the scale was changed to a dichotomous variable: 0 = has not consumed seaweed within the last month vs 1 = has consumed seaweed within the last month. This item was inspired by a similar measure of food consumption frequency used by Nystrand and Olsen (2020) and adapted to seaweed food product consumption.

3.3. Analytical procedure

The statistical analyses in this study were conducted using a two-step approach recommended by (Anderson & Gerbing, 1988). A confirmatory factor analysis (CFA) using STATA 16.0 was first used to assess the validity of the measures of the constructs (awareness of health consequences, ascription of responsibility, personal norm, intention, and consumer food innovativeness). The constructs' convergent validity and discriminant validity were established using the Fornell and Larcker (1981) methodology. There was convergent validity when the construct can explain an average of 50 per cent variance of its indicators. There was discriminant validity when the AVE of latent variables was higher than the squared correlations (SC) values of other latent variables (AVE > SC), indicating that each latent construct shares more variance with its associated indicators than with any other latent variable expressed in the model. Finally, Composite reliability (CR) (threshold of reliability CR > 0.70) was used to evaluate the reliability of the scales (Hair et al., 2010).

Using STATA 16 (software for statistics and data science), the second step consisted in using structural equation modelling with maximum likelihood estimation to test causal relationships among latent variables. In each stage, the assessment of goodness of fit was made by multiple



Fig. 2. Wakame (left), sea grapes (middle), Nori (right).

Table 2
Reliability of latent constructs in the NAM model.

Constructs and indicators	Indicator loading	Composite reliability	Average variance extracted
Awareness of health consequences		0.87	0.70
Seaweed products can be considered as superfood	0.78		
Seaweed products are good for your health	0.87		
Seaweed can be considered as the vegetable of the sea	0.85		
Ascription of responsibility		0.89	0.74
Eating seaweed can contribute to the fight against climate change	0.83		
I feel that people should eat (more) seaweed to reduce the impact of food on the climate	0.88		
Every person should eat seaweed to reduce the pressure on land resources	0.88		
Personal norm		0.92	0.81
I believe i have a moral obligation to eat more seaweed	0.90		
People like me should do whatever they can to maximise their consumption of seaweed in order to have a positive impact on the climate	0.89		
I have a good conscience when i buy seaweed known for their positive impact on the environment	0.91		
Intention (to eat seaweed)		0.95	0.87
I intend to eat products containing seaweed in the future	0.93		
I expect to eat products containing seaweed in the future	0.96		
I will try to eat products containing seaweed in the future	0.92		
Consumer food innovativeness		0.87	0.69
I am constantly sampling new and different foods	0.77		
I try new foods before other people do	0.83		
Compared to my friends, i try more new foods	0.90		

indicators: χ^2 (chi-square), CFI (comparative fit index), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) and standardised root mean residual (SRMR). According to Brown (2015), model fit is good when CFI and TLI indices > 0.90, RMSEA < 0.08 and SRMR < 0.08.

Two structural models were specified and compared to examine if the extended model outperformed the NAM model. In addition to

awareness of health consequences, ascription of responsibility, personal norms, and intention, the extended model included consumer food innovativeness and future consumption of seaweed.

A mediation analysis was run using the STATA package Medsem (Mehmetoglu, 2018), which provides a post-estimation command testing mediational hypotheses for use with structural equation modelling, using Baron and Kenny’s (1986) approach adjusted by Iacobucci et al. (2007). Medsem is an effective method for conducting mediational analysis of fairly complex models, including multiple moderators and dependent variables (Mehmetoglu, 2018).

Finally, consumer food innovativeness was proposed as a moderator to the intention and behaviour relation. Cortina’s et al. (2001) single-step estimation approach was adopted and applied to STATA as this method is considered conceptually and operationally straightforward. The interaction term was first calculated by multiplying mean-deviated values of the independent variable with the moderator variable (intention by consumer food innovativeness) to avoid multicollinearity. The interaction was then included in the structural model, and all variables were analysed simultaneously.

4. Results

4.1. Measurement model

The measurement model was estimated by conducting a CFA with a maximum likelihood estimation method. The results of the measurement model, including the five latent variables with a total of 15 indicators and one observable variable, indicated a good fit to the data $\chi^2(80) = 218.51, p < 0.001, RMSEA = 0.06, CFI = 0.97, TLI = 0.96,$ and $SRMR = 0.04$.

The validity and reliability of the measurements were assessed. There was convergent and discriminant validity of latent variables as $AVE > 0.5$ and $AVE > SC$, respectively. In addition, the CR of the latent variables were all > 0.7, indicating good construct reliability, as shown in Table 2.

The loadings revealed that the indicators were strongly related to their purposed factors, which is consistent with the position that the items adapted from the literature are reliable indicators of the constructs.

Finally, the results indicated that 26% of the participants had consumed seaweed food during last month (between t1 and t2). The results also showed significant correlations between all the factors (Table 3).

4.2. Structural model

The two models were tested using structural equation modelling (SEM) with a maximum likelihood estimation (Table 4). The results of the NAM and extended NAM, including consumer food innovativeness and future consumption, indicated adequate goodness of fit ($RMSEA = 0.07–0.06, CFI = 0.97–0.96, TLI = 0.96–0.96,$ and $SRMR = 0.04–0.06$). Personal norm ($\beta = 0.19, p < 0.001$) was significantly positively associated with intention, supporting H1. Awareness of health consequences

Table 3
Construct means, standard deviations and correlations.

	M	SD	1	2	3	4	5	6
1. Awareness of health consequences	4.61	1.27	1.00					
2. Ascription of responsibility	4.04	1.41	0.68***	1.00				
3. Personal norm	3.31	1.55	0.55***	0.75***	1.00			
4. Intention (to eat seaweed)	3.72	1.89	0.64***	0.65***	0.59***	1.00		
5. Consumer food innovativeness	3.89	1.39	0.18***	0.26***	0.23***	0.30***	1.00	
6. Future consumption	0.26	0.43	0.14**	0.13**	0.18***	0.22***	0.17**	1.00

*p < 0.05, ** p < 0.01, *** p < 0.001.

Table 4
Structural equation models and indices.

Relationships	Hypothesis testing	NAM		Extended NAM	
		β	z	β	z
Personal norm → Intention	H1 supported	0.19	2.63**	0.19	2.67**
Ascription of responsibility → Personal norm	H2 supported	0.82	39.65***	0.82	39.69***
Awareness of health consequences → Ascription of responsibility	H3 supported	0.75	27.26***	0.75	27.77***
Ascription of responsibility → Intention	H4 supported	0.23	2.43*	0.22	2.28*
Awareness of health consequences → Intention	H5 supported	0.41	6.77***	0.42	6.85***
Intention → Future consumption	H7 supported	–	–	0.22	4.58***
Consumer food innovativeness → Future consumption	H8 supported	–	–	0.12	5.27***
Intention × Consumer food innovativeness → Future consumption	H9 supported	–	–	0.25	5.24***
R ² (%) Ascription of responsibility		56.5		57.4	
R ² (%) Personal norm		67.5		67.6	
R ² (%) Intention		58.3		58.6	
R ² (%) Future consumption		–		9.2	
Model fit indices					
χ ² (df)		165.56 (49)		271.52 (97)	
RMSEA		0.07		0.06	
CFI		0.97		0.96	
TIL		0.96		0.96	
SRMR		0.04		0.06	

*p < 0.05, ** p < 0.01, *** p < 0.001

(β = 0.75, p < 0.001) was significant in explaining ascription of responsibility, while ascription of responsibility (β = 0.82, p < 0.001) significantly explained personal norm, supporting H3 and H2. Moreover, the model confirmed that ascription of responsibility was positively related with intention (H4: β = 0.23, p < 0.05) as well as the positive relation of awareness of health consequences with intention (H5: β = 0.41, p < 0.001). The model explained 67% of the variability of personal norm, and 58% of the variability of the variance of intention (Table 4).

The mediation analysis results showed that ascription of responsibility also partially mediated a proportion of the relationship between awareness of health consequences and intention. There was statistically significant bivariate relation between awareness of health consequences and the mediator ascription of responsibility with (β =

0.75, p < 0.001), as well as between the mediator ascription of responsibility and intention (β = 0.33, p < 0.05). Moreover, the test confirmed the significant relationship between health consequence and intention (β = 0.64, p < 0.001) as well as the Sobel’s test was significant.

The results supported H7 that intention predicted future consumption of seaweed (β = 0.22, p < 0.001) and that consumer food innovativeness is positively associated with future consumption of seaweed (H8: β = 0.12, p < 0.001). Furthermore, the results revealed that consumer food innovativeness plays a moderating role in the relationship between intention and future seaweed consumption (β = 0.25p < 0.001), supporting hypothesis H9. Finally, intention and consumer food innovativeness together explained 9.2% of the variance of future consumption of seaweed.

5. Discussion

The primary aim of this study was to examine the ability of an extended NAM framework in explaining the consumption of seaweed foods in Norway. Hence, the study proposed and tested the NAM to explain intention to consume seaweed. The results confirmed that intention to eat seaweed is the activation of personal norms by ascription of responsibility. Ascription of responsibility was found to be highly associated with personal norm. Moreover, we also confirmed a high relationship between awareness of health consequences and ascription of responsibility, indicating the importance of health information in forming ascription of responsibility. These results corroborate with other studies that used NAM to predict diverse environmentally friendly intention (Han et al., 2020; Kim & Hwang, 2020; Park & Ha, 2014) and indicate that health benefits are important for explaining the formation of food attitudes, intention, and behaviour concerning foods like seaweed (Hwang et al., 2016; Lee et al., 2013; Rana & Paul, 2017).

The second aim of this study was to explore the direct relationship between awareness of health consequences and intention as well as the direct relationship between ascription of responsibility and intention. In this regard, the model confirmed that both awareness of health consequences and ascription of responsibility have a direct positive relationship with intention. Moreover, the results showed that ascription of responsibility partially mediated the relationship between awareness of health consequences and intention. Partial mediation implies that there is not only a significant relationship between ascription of responsibility and intention, but also a relationship between awareness of health consequences and intention. This empirically confirms that awareness of consequences is a key variable when predicting intention to eat seaweed. These results are in accordance with Vaske et al. (2015) and previous NAM studies opening up for those alternative relationships (Kim et al., 2018; Rezaei et al., 2019; Zhang et al., 2017). Moreover, the awareness of health consequences construct has a stronger influence on intention to eat seaweed than sustainable or environmental responsibility. These results align with Magnusson et al. (2003), who showed that egoistic motives, such as health are stronger predictors of organic food consumption than altruistic or biospheric motives. As indicated above, the study also confirmed a strong positive relation between awareness of health consequences and ascription of responsibility. Indicating that as people become aware of the health consequence of seaweed, they feel personally responsible for its

consumption. This finding is in accordance with [Asif et al. \(2018\)](#), as they indicated that health consciousness is a more significant predictor of consumer behaviour towards organic foods than environmental concern. [Birch et al. \(2018\)](#) also indicate that health consciousness may influence local food consumption decisions more strongly than sustainable motivations.

The strong positive relationship between personal norm and sustainable intentional behaviour is confirmed in various contexts, such as recycling, environmentally friendly travel alternatives, and electricity saving ([Eriksson et al., 2008](#); [Jansson et al., 2011](#); [Wüdegren, 1998](#)). In the context of seaweed food consumption, personal norm affects intention, but the results suggest that personal norm has the lowest path coefficient of the factors affecting intention. Following [Green \(2016\)](#), personal norm generally changes at a slow pace. In the case of novel food consumption, we argued that the novel and unfamiliar aspect of seaweed hinders the formation of personal norms regarding seaweed. In other words, the weaker effect of personal norm on intention could be explained by the difficulty of individuals' self-expectation regarding seaweed consumption due to unfamiliarity and lack of knowledge about seaweed.

The study extended the NAM model to use a prospective design and to include consumer food innovativeness. The first aim was to verify the ability of intention to predict and explain future consumption of seaweed. Assessed one month after prediction, the results confirmed the positive effect of intention on future consumption. However, the results showed that intention only explained 9% of the variance of the consumption of seaweed during the last month. This confirmed that the gap between intention and pro-environmental behaviour ([ElHaffar et al., 2020](#)) and between intention and behaviour in the context of novel foods ([Chekima et al., 2017](#); [Schäufele & Hamm, 2018](#)) can be problematic. There can be different reasons for this. For example, individuals can expose an optimistic intention of positive behaviour as a social desirability effect ([Grimm, 2010](#)), lack of knowledge on how to prepare or use novel food and low availability of seaweed in the Norwegian market.

The final aim of this study was to investigate the relationship between consumer food innovativeness and seaweed consumption and moderating effect of consumer food innovativeness on the intention-future consumption relationship. The results first confirmed that consumer food innovativeness is positively related to future consumption, indicating that food innovative consumers are more likely to consume seaweed. This result provides positive news to the seaweed industry as food innovative consumers are more likely to spend time and money to find new food products ([McCarthy et al., 2001](#)). Moreover, food innovative consumers are also likely to spread positive feedback or to introduce the food to other consumers ([Goldsmith, 2001](#); [Payini, Ramaprasad, Mallya, Sanil, & Patwardhan, 2020](#)). Furthermore, the results showed that the relationship between intention and behaviour is stronger when consumers are food innovative, confirming that food innovative consumers are more likely to bridge the gap between intending to consume seaweed and consuming seaweed.

In practical or managerial terms, this study confirms previous NAM studies demonstrating that the activation of personal norm increases intention. Hence, the feeling of environmental obligation to eat seaweed is activated by consumer feeling of environmental responsibility and awareness of health consequences. Second, this study underlines the important role of health consequences on consumer intention to eat seaweed. Additionally, the feeling of responsibility to reduce environmental problems plays a role in consumers' intention to eat seaweed. This finding is important for the development of seaweed products that provide good nutritional value. Targeting campaigns should target food innovative consumers with higher levels of health and environmental consciousness as they are more likely to eat seaweed foods. Finally, seaweed food marketers should target food innovative consumers by underlining the novelty and uniqueness of seaweed food products as they are more likely to consume seaweed.

5.1. Limitations and future research

The current research suffers from some limitations that could provide future research opportunities. First, this study relies on self-reported data which causes social desirability bias ([Ceri et al., 2019](#); [Fisher & Katz, 2000](#)). Hence, we believe that respondents may overestimate their intention to eat seaweed food as it can be socially desirable to display pro-environmental behaviour. The social desirability bias might also explain the gap between intention and behaviour since social expectations, that is approval of consumption, may play a role in explaining seaweed consumption. A few NAM studies have shown a direct effect of social norms on pro-environmental intention ([Kim & Hwang, 2020](#); [Kim et al., 2018](#); [Rezaei et al., 2019](#); [Shin et al., 2018](#)). However, future research is needed to study the moderating effect of social norms on the relationship between intention and behaviour.

Regarding the causal relationship in the NAM, this study found similar results to [Onwezen et al. \(2013\)](#); we observed high path coefficient between awareness of health consequences-ascription of responsibility and ascription of responsibility- personal norm. The study also showed that a high path coefficient between personal norm and intention was revealed when applying the original linear NAM, which is similar to that of previous NAM studies (e.g., [Han, 2014](#); [Han et al., 2019](#); [Kim & Hall, 2020](#)). However, when extending the causal relationships, we observed a decrease in the personal norm-intention relationship, indicating that other variables explain the variation in variance of intention. Hence, future studies should extend the causal relationships of the NAM to verify any change in the variance of intention. Several studies that have extended the NAM with the help of the TPB ([Kim & Hwang, 2020](#); [Rezaei et al., 2019](#); [Shin et al., 2018](#)) have shown the relevance of attitude and perceived behaviour control in explaining the variance of intention. Therefore, it would be of interest to associate the NAM with TPB in the context of seaweed food consumption.

Moreover, intention and consumer food innovativeness only explained 9% of the variance. This result has to be put in perspective, as factors, such as seaweed foods' availability ([Vermeir & Verbeke, 2006](#)) might also explain the gap between intention and (future) behaviour. In Norway, seaweed foods are difficult to access as they are only available in international and high-end stores. Hence, future studies should also examine if the variance of behaviour is explained when using factors such as actual behaviour control. Future studies could also examine the difference between the consumers living in urban and rural areas, as the consumers living in cities have higher access to seaweed foods.

Furthermore, as consumers are unfamiliar with seaweed, they could have preconceived ideas and attitudes about its taste and smell, which are two of the most important attributes of food choice ([Clark, 1998](#)). Hence, future research will also need consumer test studies with sensory tests ([Lawless & Heymann, 2010](#)) to explore consumer preferences, attitudes, expectations, willingness to pay, and experiences after trying seaweed products. There is also a possibility to explore reasons why innovative individuals are more motivated to try seaweed products.

Finally, this study focused on Norway, where seaweed is considered a new and unfamiliar product. However, consumer behaviour varies according to country, culture, availability, knowledge, and experiences. Explaining and understanding environmental and sustainable values ([De Groot & Steg, 2008](#); [Schwartz, 1992](#)), attitudes and behaviour across borders ([Milfront et al., 2010](#); [Olsen et al., 2008](#)), cultures, and contexts could be an interesting and necessary future research stream ([Morren & Grinstein, 2016](#); [Tam & Chan, 2017](#)). Comparing countries with low seaweed consumption experience (e.g., Europe) and long traditions of seaweed consumption (e.g., China, Vietnam, Japan, and South Korea) using the NAM can be a topic of future research.

6. Conclusion

This study contributes to explaining seaweed food consumption by

using the norm activation framework. The results of the structural equation analysis performed on a sample of Norwegian consumers confirmed the overall robustness of the norm activation framework. Furthermore, the extended model increased the explained variance in intention by 13% and provided a clearer understanding of consumers' motivation to consume seaweed food. This study also highlighted the relevance of awareness of health consequences on intention to eat seaweed, suggesting that consumers are motivated to consume seaweed if they believe that seaweed has positive health consequences. In addition, the association of ascription of responsibility and personal norm with intention to eat seaweed indicated that environmental consideration plays an important role in the formation of intention. Intention and consumer food innovativeness are associated with future seaweed consumption, suggesting that food innovative consumers are more likely to consume seaweed food. However, there remains an explanatory gap between intention and future behaviour that should be studied further.

Finally, this study provides practical implications for seaweed marketers, as they should target innovative food consumers as well as consumers who are aware of their health and are environmentally conscious. As health awareness and environmental considerations are important factors in explaining consumer intention and consumption, the seaweed industry should concentrate on developing and promoting healthy and environmental seaweed food products.

7. Author statement

This manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal. All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these. There are no conflicts of interest to declare, and the manuscript has been proofed by a professional company.

Funding

This research was supported by a PhD scholarship grant from NordForsk.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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